

## WE CLAIM:

1. A method for calculating a shape of at least one band-shaped superconductor in at least one coil section of a high-field magnet coil, the shape extending through a transfer region towards or away from that coil section, the coil section being wound in a solenoid fashion on a cylindrical coil body, the method comprising the step of:

mapping the band-shaped superconductor in the transfer region between a first orientation, tangentially flatly abutting a surface of the cylindrical coil body and substantially perpendicular to a longitudinal direction of that cylindrical coil body, and second orientation in which a narrow side of the band-shaped superconductor seats on the surface of the cylindrical coil body and extends substantially parallel to the longitudinal direction, wherein a path  $z(u)$  of the band shaped superconductor through the transfer region is determined from the following integral-differential equation

$$\frac{z''(u)}{(1 + z'(u)^2)^{3/2}} = \frac{\sin(\tau \int_0^u d\hat{u} \sqrt{1 + z'(\hat{u})^2})}{r_{\min}}$$

wherein  $z$  is a coordinate of the band-shaped superconductor in the longitudinal direction of the coil body,  $u$  an azimuthal coordinate of the band-shaped superconductor,  $\hat{u}$  an auxiliary coordinate,  $\tau$  a constant torsion in the transfer region, and  $r_{\min}$  a minimum bending radius of the band-shaped superconductor about its wide side, wherein  $z=0$ ,  $u=0$  defines a boundary point of the transfer region.

2. The method of claim 1, further comprising defining an angle  $\phi$  between a flat side of the band-shaped superconductor and a local surface of the cylindrical coil body according to the relationship

$$\varphi(u) = \tau \int_0^u d\hat{u} \sqrt{1 + z'(\hat{u})^2}$$

3. The method of claim 1, wherein  $\tau$  is a maximum admissible torsion  $\tau_{\max}$  of the band-shaped superconductor.
- 5 4. The method of claim 1, wherein the path  $z(u)$  and/or an angular behavior of  $\varphi(u)$  are determined using numerical methods.
5. The method of claim 1, wherein  $z(0)=0$  and  $z'(0)=0$  are selected as initial conditions.
- 10 6. The method of claim 1, further comprising multiplying the minimum bending radius  $r_{\min}$  of the band-shaped superconductor with respect to its broad side by a safety factor S1 and multiplying a maximum admissible torsion  $\tau_{\max}$  by a safety factor S2.
- 15 7. The method of claim 6, wherein  $S1 \leq 1.20$  and  $S2 \geq 0.8$ .
8. A high-field magnet coil having the transfer region of the at least one band-shaped superconductor as calculated using the method of claim 1.
- 20 9. A high-field magnet coil with at least one coil section, wherein the coil section is wound with at least one band-shaped superconductor in a solenoid fashion onto a cylindrical coil body, the magnet coil comprising:
 

25 at least one transfer region in which it the band-shaped superconductor is mapped between a first orientation, tangentially flatly abutting a surface of the cylindrical coil body and substantially perpendicular to a longitudinal direction of the cylindrical coil body, and a second orientation in which a narrow

30 side of the band-shaped superconductor seats on the surface of

the cylindrical coil body to extend parallel to the longitudinal direction of the cylindrical coil body.

- 5 10. The high-field magnet coil of claim 9, wherein a path of the band-shaped superconductor is fixed by a groove in the cylindrical coil body disposed in the transfer region.
- 10 11. The high-field magnet coil of claim 10, wherein a bottom said groove does not follow a torsion of the band shaped superconductor and extends on a surface of a cylinder.
12. The high-field magnet coil of claim 9, wherein the band-shaped superconductor comprises a high-temperature superconductor (HTSC).
- 15 13. The high-field magnet coil of claim 9, further comprising at least one additional coil section which is disposed radially further outwards of said coil section.
- 20 14. The high-field magnet coil of claim 13, wherein said additional coil section projects beyond said coil section in an axial direction.
- 25 15. The high-field magnet coil of claim 9, wherein a minimum admissible bending radius  $r_{\min}$  of the band-shaped superconductor has an order of magnitude equal to an order of magnitude of a radius  $r_0$  of the cylindrical coil body of a radially innermost coil section.
16. The high-field magnet coil of claim 9, wherein the high-field magnet coil is structured to generate a magnetic induction strength  $>20\text{T}$ .
- 30 17. The high-field magnet coil of claim 9, wherein an operating temperature is less than or equal to approximately 4K.

18. The high-field magnet coil of claim 9, wherein all coil sections are connected in series.
- 5 19. The high-field magnet coil of claim 9, wherein all coil sections are operated in persistent current mode.
20. The high-field magnet coil of claim 9, wherein all coil sections which do not contain HTSC are connected in series.
- 10 21. The high-field magnet coil of claim 20, further comprising means for operating a coil section containing HTSC using a separate power supply unit.
- 15 22. An NMR (nuclear magnetic resonance) high-field magnet coil system comprising superconducting conductor structure for generating a homogeneous magnetic field  $B_0$  in a measuring volume, the magnet coil system comprising the high-field magnet coil of claim 9.
- 20 23. A device for producing a high-field magnet coil using the method of claim 1, the device comprising a computer for calculating the shape of the band-shaped superconductor in the transfer region.
- 25 24. The device of claim 23, further comprising milling or erosion means for computer controlled generation of a groove in the cylindrical coil body.